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Suggested Specifications for Concrete Floors

"Concrete for Permanence"

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NOTE

These specifications apply to floors in buildings, whether subjected to moderate or heavy traffic, and cover the laying and finishing of the floor; also its protection during early hardening.

For architects, engineers and others desiring to embody these specifications in their general specifications covering a particular piece of work, the following outline of the paragraphs necessary to meet different conditions will prove convenient:

FLOORS LAID ON GROUND—Moderate or Light Traffic.

TWO-COURSE—Paragraphs 1-15 (except 2c); 30-47; 49-52.

ONE-COURSE—Paragraphs 1-15 (except 2c and b); 30-42; 53-57.

FLOORS LAID ON GROUND—Heavy Traffic.
TWO-COURSE—Paragraphs 1-15; 30-46; 48-52.

REINFORCED CONCRETE FLOORS—Moderate or Light Traffic; Paragraphs 1-22 (except 2c); 24-29.

Heavy Traffic; Paragraphs 1-23; 25-29.

PORTLAND CEMENT ASSOCIATION,
111 West Washington Street,
Chicago.

Suggested Specifications for Concrete Floors

GENERAL REQUIREMENTS

MATERIALS

1. CEMENT: The cement shall meet the requirements of the current Standard Specifications for Portland Cement adopted by the American Society for Testing Materials. The cement when used shall be in perfect condition and contain no lumps which cannot be pulverized between the fingers.

2. AGGREGATES: Before delivery on the job, the contractor shall submit to the architect or engineer a fifty (50) pound sample of each of the aggregates proposed for use. These samples shall be tested, and if found to pass the requirements of the specifications, similar material shall be considered as acceptable for the work. In no case shall aggregates containing frost or lumps of frozen material be used.

(a) *Fine Aggregate:* Fine aggregate shall consist of natural sand or screenings from hard, tough, crushed rock or gravel, consisting of quartzitic grains or other equally hard material graded from fine to coarse, with the coarse particles predominating. Fine aggregate, when dry, shall pass a screen having four (4) meshes to the linear inch; not more than twenty-five (25) per cent shall pass a sieve having fifty (50) meshes per linear inch; and not more than five (5) per cent shall pass a sieve having one hundred (100) meshes per linear inch. Fine aggregate shall not contain vegetable or other organic matter nor more than three (3) per cent by weight of clay or loam. Field tests may be made by the architect or engineer on fine aggregate as delivered at any time during progress of the work. If there is more than five (5) per cent of clay or loam by volume in one (1) hour's settlement after shaking in an excess of water, the material represented by the sample shall be held pending laboratory tests.

Fine aggregate shall be of such quality that mortar composed of one (1) part Portland cement and three (3) parts fine aggregate, by weight, when made into briquets, shall show a tensile strength at seven (7) and twenty-eight (28) days at least equal to the strength of briquets composed of one (1) part of the same cement and three (3) parts Standard Ottawa sand, by weight. The percentage of water used in making the briquets of cement and fine aggregate shall be such as to produce a mortar of the same consistency as that of the Ottawa sand briquets of Standard consistency. In other respects all briquets shall be made in accordance with the methods of testing cement recommended by the American Society for Testing Materials. (See Cement Specifications A. S. T. M.)

(b) *Coarse Aggregate:* Coarse aggregate shall consist of clean, hard, tough, crushed rock or pebbles graded in size, free from vegetable or other organic matter, and shall contain no soft, flat or elongated particles. The size of the coarse aggregate shall range from one and one-half (1½) inches down, not more than five (5) per cent passing a screen having four (4) meshes per linear inch, and no intermediate sizes shall be removed.

(c) *No. 1 Aggregate for Wearing Course:* No. 1 aggregate for the wearing course shall consist of clean, hard, tough, crushed rock or pebbles, free from vegetable or other organic matter, and shall contain no soft, flat or elongated particles. It shall pass when dry a screen having one-half (½) inch openings and not more than ten (10) per cent shall pass a screen having four (4) meshes per linear inch.

3. MIXED AGGREGATE: Crusher-run stone, bank-run gravel or mixtures of fine and coarse aggregate prepared before delivery on the work shall not be used.

4. SUBBASE: Only clean, hard material, such as coarse gravel or steam-boiler cinders, free from ash or particles of unburned coal, shall be used in the subbase. (Note: Eliminate this clause when subbase is not required.)

5. WATER: Water shall be clean, free from oil, acid, alkali or vegetable matter.

6. COLOR: If artificial coloring matter is required, only those mineral colors shall be used which, in the amount hereinafter specified, will not appreciably impair the strength of the cement.

7. REINFORCEMENT: The reinforcing metal shall meet the requirements of the current Standard Specifications for Steel Reinforcement of the American Society for Testing Materials. It shall be free from excessive rust, scale, paint or coatings of any character which will tend to reduce or destroy the bond.

8. JOINT FILLER: The joint filler shall be a suitable compound that will not become soft and run out in hot weather, nor hard and brittle and chip out in cold weather; or, prepared strips of fibre matrix and bitumen as approved by the architect or engineer. The strips shall be one-half (½) inch in thickness and their width shall at least equal the full thickness of the slab.

MEASURING AND MIXING

9. MEASURING: The method of measuring the materials for the concrete or mortar, including water, shall be one which will insure separate and uniform proportions of each of the materials at all times. A sack of Portland cement (94 pounds net) shall be considered as one (1) cubic foot.

10. MACHINE MIXING: All concrete shall be mixed by machine except when the architect or engineer shall otherwise permit under special conditions. A batch mixer of an approved type shall be used. The ingredients of the concrete or mortar shall be mixed to the specified consistency, and the mixing shall continue for at least one (1) minute after all the materials are in the drum. Raw materials shall not be permitted to enter the drum until all the material of the preceding batch has been discharged.

11. HAND MIXING: When it is necessary to mix by hand, the materials shall be mixed dry on a watertight platform until the mixture is of uniform color, the required amount of water added, and the mixing continued until the mass is of uniform consistency and homogeneous.

12. RETEMPERING: Retempering of mortar or concrete which has partially hardened, that is, remixing with or without additional materials or water, shall not be permitted.

PROTECTION

13. TREATMENT: As soon as the finished floor has hardened sufficiently to prevent damage thereby, the floor shall be covered with at least one (1) inch of wet sand, or two (2) inches of sawdust, which shall be kept wet by sprinkling with water for at least ten (10) days.

14. PROTECTION: The freshly-finished floor shall be protected from hot sun and drying winds until it can be sprinkled and covered as above specified. The concrete surface must not be damaged or pitted by raindrops, and the contractor shall provide and use when necessary sufficient tarpaulins to completely cover all sections that have been placed within the preceding twelve (12) hours.

15. TEMPERATURE BELOW 35 DEGREES FAHRENHEIT: If at any time during the progress of the work the temperature is, or in the opinion of the architect or engineer will within twenty-four (24) hours drop to, 35 degrees Fahrenheit, the water and aggregates shall be heated and precautions taken to protect the work from freezing for at least five (5) days.

REINFORCED CONCRETE FLOORS

For reinforced concrete floors the following will apply in addition to the general requirements:

16. FORMS: The forms shall be substantial, unyielding and so constructed that the concrete will conform to the designed dimensions and contours, and shall also be tight to prevent the leakage of mortar. The supports for floors shall not be removed in less than ten (10) days after the concrete is placed, and then only with the consent of the architect or engineer in charge. When freezing weather occurs, the supports shall remain in place an additional time, equal to the time the floor has been exposed to freezing.

17. REINFORCEMENT: Reinforcing metal shall be provided as called for on the plans. It shall be placed as indicated and mechanically held in position so that it will not become disarranged during the depositing of the concrete. Whenever it is necessary to splice tension reinforcement, the character of the splice shall be such as will develop its full strength. Splices at points of maximum stress shall be avoided. Splicing by lapping bars without contact and with space between bars along the over-lap equal to twice the thickness of the bars is preferable to mechanical splices or clamps.

CONCRETE SLAB

18. PROPORTIONS: The concrete shall be mixed in the proportions by volume of one (1) sack of Portland cement, two (2) cubic feet of Fine Aggregate and four (4) cubic feet of Coarse Aggregate.

19. CONSISTENCY: The materials shall be mixed wet enough to produce a concrete of a consistency that will flow into the forms and about

the reinforcement, but which can be conveyed from the mixer to the forms without the separation of the coarse aggregate from the mortar.

20. PLACING: The concrete shall be placed in a manner to insure a smooth ceiling, and thoroughly worked around the reinforcement and into the recesses of the forms. Concrete shall be deposited in its full position as soon as possible after mixing and within thirty (30) minutes after the water has been added to the dry materials. It shall be struck off to a surface at least one (1) inch below the established grade of the finished surface of the floor. Workmen shall not be permitted to walk in freshly-laid concrete, and if sand or dust collects on the base, it shall be carefully removed before the wearing course is applied.

21. JOINTS: When it is necessary to make a joint in a floor slab, its location shall be designed by the architect or engineer; joints to be vertical.

WEARING COURSE

22. PROPORTIONS AND THICKNESS (Mixture No. 1): The mortar shall be mixed in the proportions of one (1) sack of Portland cement and two (2) cubic feet of Fine Aggregate. The minimum thickness shall be three-quarters (¾) inches.

23. PROPORTIONS AND THICKNESS (Mixture No. 2): The mortar shall be mixed in the proportions of one (1) sack of Portland cement, one (1) cubic foot of Fine Aggregate and one (1) cubic foot of No. 1 Aggregate for Wearing Course. The minimum thickness shall be one (1) inch.

24. CONSISTENCY: The mortar shall be of the dryest consistency possible to work with a sawing motion of the strikeboard.

25. PLACING: The wearing course shall be placed immediately after mixing. It shall be deposited on the fresh concrete of the base before the latter has appreciably hardened, and brought to the established grade with a strikeboard.

NOTE: When placing the wearing course after the concrete slab has hardened, eliminate paragraph 25 and substitute the following:

26. PREPARATION OF SLAB: The surface of the slab shall be thoroughly roughened by picking, and swept clean of all dirt and debris.

27. PLACING: The slab shall be thoroughly moist but free from pools of water when the grout and mortar for wearing course is placed. A neat cement grout shall be brushed on the surface of the slab, the wearing course immediately applied and brought to the established grade with a strikeboard. Grout and mortar shall be used within forty-five (45) minutes after mixing with water.

28. FINISHING: After the wearing course has been brought to the established grade by means of a strikeboard, it shall be worked with a wood float in a manner which will thoroughly compact it and provide a surface free from depressions or irregularities of any kind. When required, the surface shall be steel-troweled, but excessive working shall be avoided. In no case shall dry cement or a mixture of dry cement and sand be sprinkled on the surface to absorb moisture or to hasten the hardening, but the Bruner method may be used if desired.

29. COLORING: If artificial coloring is used, it must be incorporated with the entire wearing course and shall be mixed dry with the cement and aggregate until the mixture is of uniform color. In no case shall the amount of coloring exceed five (5) per cent of the weight of the cement.

PLAIN CONCRETE FLOORS

For plain concrete floors the following will apply in addition to the general requirements:

SUBGRADE

30. PREPARATION: All soft and spongy places shall be removed and all depressions filled with suitable material which shall be thoroughly compacted in layers not exceeding six (6) inches in thickness. The subgrade shall be thoroughly tamped until it is brought to a firm, unyielding surface.

31. DEEP FILLS: All fills shall be made in a manner satisfactory to the architect or engineer. The use of muck, quick-sand, soft clay, spongy or perishable material is prohibited.

32. DRAINAGE: When required, a suitable drainage system shall be installed and connected with sewers or other drains indicated by the engineer.

33. DEPTH: The subgrade shall be not less than.....(00) inches below the finished surface of the floor.

NOTE: Subgrade to be five (5) inches below the finished surface of the floor when subbase is not required, and at least eleven (11) inches below when subbase is required.

SUBBASE

(Omit these sections when subbase is not required.)

34. THICKNESS: On the subbase shall be spread a material as hereinbefore specified, which shall be thoroughly rolled or tamped to a surface at least .....(00) inches below the finished grade of the floor. On fills, the subbase shall extend the full width of the fill.

35. WETTING: While compacting the subbase, the material shall be kept thoroughly wet, and shall be in that condition when the concrete is deposited.

FORMS

36. MATERIALS: Forms shall be free from warp and of sufficient strength to resist springing out of shape.

37. SETTING: The forms shall be well staked or otherwise held to the established lines and grades and their upper edges shall conform to the established grade of the floor.

38. TREATMENT: All wood forms shall be thoroughly wetted and metal forms oiled or coated with soft soap or whitewash before depositing any material against them. All mortar and dirt shall be removed from forms that have been previously used.

CONSTRUCTION

39. SIZE OF SLABS: The slabs or independently-divided blocks when not reinforced shall have an area of not more than one hundred (100) square feet, and shall not have dimensions greater than ten (10) feet. Larger slabs shall be reinforced as hereinafter specified.

40. THICKNESS OF FLOOR: The thickness of the floor shall be not less than five (5) inches.

41. WIDTH AND LOCATION OF JOINTS: When required by the architect or engineer in charge, a one-half (½) inch space or joint shall be left between the floor and the walls and columns of the building, to be filled with the material before specified under "Joint Filler."

42. PROTECTION OF EDGES: Where required by the architect or engineer in charge, the edges of the slabs at the joints shall be protected by metal. Unless protected by metal, the upper edges of the slabs shall be rounded to a radius of one-half (½) inch.

CONCRETE BASE

(Two-Course Floor)

43. PROPORTIONS: The concrete shall be mixed in the proportions by volume of one (1) sack of Portland cement, two and one-half (2½) cubic feet of Fine Aggregate and five (5) cubic feet of Coarse Aggregate.

44. CONSISTENCY: The materials shall be mixed wet enough to produce a concrete of a consistency that will flush readily under slight tamping, but which can be handled without causing a separation of the coarse aggregate from the mortar.

45. PLACING: After mixing, the concrete shall be handled rapidly and the successive batches deposited in a continuous operation completing individual sections to the required depth and width. Under no circumstances shall concrete that has partly hardened be used. The forms shall be filled and the concrete struck off and tamped to a surface the thickness of the wearing course below the established elevation of the floor. The method of placing the various sections shall be such as to produce a straight, clean-cut joint between them so as to make each section an independent unit. If dirt, sand or dust collects on the base it shall be removed before the wearing course is applied. Workmen shall not be permitted to walk on the freshly-laid concrete. Any concrete in excess of that needed to complete a section at the stopping of work shall not be used. In no case shall concrete be deposited upon a frozen subgrade or subbase.

46. REINFORCING: Slabs having an area of more than one hundred (100) square feet, or having dimensions greater than ten (10) feet, shall be reinforced with wire fabric, or with plain or deformed bars. The reinforcement shall have a weight of not less than twenty-eight (28) pounds per one hundred (100) square feet. The reinforcement shall be placed upon and slightly pressed into the concrete base immediately after the base is placed. It shall not cross joints and shall be lapped sufficiently to develop the full strength of the metal.

WEARING COURSE

47. PROPORTIONS FOR MIXTURE NO. 1: The wearing course shall be mixed in the proportions of one (1) sack of Portland cement, two (2) cubic feet of Fine Aggregate. The minimum thickness shall be three-quarters (¾) inches.

48. PROPORTIONS FOR MIXTURE NO. 2: The wearing course shall be mixed in the proportions of one (1) sack of Portland cement and one (1) cubic foot of Fine Aggregate, and one (1) cubic foot on No. 1 Aggregate for Wearing Course. The minimum thickness shall be one (1) inch.

49. CONSISTENCY: The mortar shall be of the dryest consistency possible to work with a sawing motion of the strikeboard.

50. PLACING: The wearing course shall be placed immediately after mixing. It shall be deposited on the fresh concrete of the base before the latter has appreciably hardened, and brought to the established grade with a strikeboard. In no case shall more than forty-five (45) minutes elapse between the time the concrete for the base is mixed and the wearing course is placed.

51. FINISHING: After the wearing course has been brought to the established grade by means of a strikeboard, it shall be worked with a wood float in a manner which will thoroughly compact it and provide a surface free from depressions or irregularities of any kind. When required, the surface shall be steel-troweled, but excessive working shall be avoided. In no case shall dry cement or a mixture of dry cement and sand be sprinkled on the surface to absorb moisture or to hasten the hardening, but the Bruner method may be used if desired. Unless protected by metal the surface edges of all slabs shall be rounded to a radius of one-half (½) inch.

52. COLORING: If artificial coloring is used, it must be incorporated with the entire wearing course, and shall be mixed dry with the cement and aggregate until the mixture is of a uniform color. In no case shall the amount of coloring exceed five (5) per cent of the weight of the cement.

ONE-COURSE FLOOR

53. PROPORTIONS: The concrete shall be mixed in the proportions of one (1) sack of Portland cement to not more than two (2) cubic feet of Fine Aggregate and not more than three (3) cubic feet of Coarse Aggregate, and in no case shall the volume of the Fine Aggregate be less than one-half (½) the volume of the Coarse Aggregate.

A cubic yard of concrete in place shall contain not less than six and eight-tenths (6.8) cubic feet of cement.

54. CONSISTENCY: The materials shall be mixed with sufficient water to produce a concrete which will hold its shape when struck off with a strikeboard. The consistency shall not be such as to cause a separation of the mortar from the coarse aggregate in handling.

55. PLACING: After mixing, the concrete shall be handled rapidly and the successive batches deposited in a continuous operation competing individual sections to the required depth and width. Under no circum-

stances shall concrete that has partly hardened be used. The forms shall be filled and the concrete brought to the established grade with a strikeboard. The method of placing the various sections shall be such as to produce a straight, clean-cut joint between them so as to make each section an independent unit. Any concrete in excess of that needed to complete a section at the stopping of work shall not be used. Workmen shall not be permitted to walk on the freshly-laid concrete. In no case shall concrete be deposited upon a frozen subgrade or subbase.

56. REINFORCING: Slabs having an area of more than one hundred (100) square feet, or having any dimensions greater than ten (10) feet, shall be reinforced with wire fabric or with plain or deformed bars. The reinforcement shall have a weight of not less than twenty-eight (28) pounds per one hundred (100) square feet. The reinforcement shall be placed upon and slightly pressed into the concrete base immediately after the base is placed. It shall not cross joints and shall be lapped sufficiently to develop the full strength of the metal.

57. FINISHING: After the concrete has been brought to the established grade by means of a strikeboard, and has hardened somewhat, but is still workable, it shall be floated with a wood float in a manner which will thoroughly compact it and provide an even surface. When required, the surface shall be steel-troweled, but excessive working shall be avoided. Unless protected by metal the surface edges of all slabs shall be rounded one-half (½) inch.

Irving J. Gill, a well-known architect in Los Angeles, Cal., writing in The Architect and Engineer of California, for March 1916, says:

> *"Concrete floors are cheaper than wood for the first story; they are enduring, they require a minimum of care, they are comfortable and healthful when laid right, and they can be more beautiful than any other floor."*

Specifications for Concrete Roads, Streets and Alleys

Specifications for Concrete Paving Between Street Car Tracks

Suggested Specifications for Reinforced Concrete Design

Suggested Specifications for Concrete Sidewalks

Suggested Specifications for Concrete Tennis Courts

Suggested Specifications for Concrete Swimming Pool

Suggested Specifications for Small Tanks and Reservoirs

Are Specifications that can be had free of charge, on request of the Portland Cement Association.